Wisconsin Emerald Ash Borer
Strategic Plan

A project of the Wisconsin Cooperative Emerald Ash Borer Program

May 2014








Wisconsin Emerald Ash Borer Strategic Plan
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Wisconsin Emerald Ash Borer Strategic Plan

I. Purpose of Plan

The Wisconsin Department of Agriculture, Trade and Consumer Protection and the Department of Natural Resources have developed this strategic plan to help guide prioritization, development and implementation of actions related to threats and harm caused by Emerald Ash Borer (EAB) in the state. This plan will guide selection of yearly goals described in each years EAB Response Strategies and Program Activities Document. This plan was created with the input of the University of Wisconsin-Madison, USDA Animal and Plant Health Inspection Service – Plant Protection and Quarantine, and the USDA Forest Service. Many key partners and stakeholders have contributed to this plan.

This Wisconsin Emerald Ash Borer Management Plan is a living document that will be posted electronically for use by all participating agencies. The agencies will modify the document as needed to incorporate new opportunities for management as they develop. When an update is done, the agencies will seek input from partners and constituencies on appropriate enhancements or adjustments to the plan.

It should be noted that this plan is a programmatic strategy, not a budget or investment strategy. While each of the objectives and associated strategies is deemed to be appropriate in its own right, limits of available funding or other resources to implement strategies may influence actions selected for implementation through the decision making process described in this document.

II. Desired Outcomes

A. Prevention:

1. Movement of infested or potentially infested material is regulated by state and federal agencies and local municipalities to prevent artificial introductions of EAB.
2. Introductions by the public and businesses are reduced.
3. Populations of EAB are detected as early as practical and this information used to minimize losses from the pest.

B. Preparedness:

1. State agencies, tribes, communities, businesses and landowners are aware of actions that can be taken in advance of damage from EAB in order to minimize economic losses from the pest.
2. Communities, Tribes, businesses and landowners are aware of existing technical and financial assistance for undertaking actions to prepare for EAB and to advocate for federal cost sharing for such activities.

C. Manage/Mitigate Impacts of EAB: State agencies, tribes, communities, businesses and landowners have the tools and resources available to respond to an infestation of EAB, either directly or through awareness of available contracted services.
D. Suppress EAB Populations: State agencies, tribes, communities, businesses and landowners have options to reduce EAB populations and the damage they cause.
E. Utilize/Salvage Removed Wood: Ash trees removed due to death, infestation or in preparation for EAB arrival do not become a disposal problem and expense but are utilized for some return to the state, tribes, communities, businesses or individuals which owned them.
F. Preserve or Restore Ecosystem Functions Impacted by EAB: Ecological impacts of EAB are minimized, ecological functions of affected ecosystems are restored as close as practical to levels prior to infestation, and resiliency of surviving forest is improved.
G. Roles and responsibilities of all Cooperative Program participants: Roles and responsibilities are clearly understood by participants and non-participants. How these roles and responsibilities are integrated and coordinated to achieve common program goals is also clear to all.
H. Sufficient Funding: Adequate funding to support state and local efforts for survey, regulation, management, research, and educational activities to minimize EAB impact on the forests and the people of Wisconsin is obtained.
I. High Public Awareness: The public is aware of actions and results of the EAB program and how these benefit Wisconsin landowners, communities and forests. They are also aware that the program is a cooperative, coordinated, multi-agency effort.

III. Key Messages

A. Emerald ash borer is the most destructive forest insect introduced into North America in recent history.
B. Our present ability to detect, contain, eradicate, or manage EAB infestations is limited. The eventual loss of the majority of ash trees in Wisconsin should be anticipated.
C. EAB infestations are distributed across a much greater geographical region of the country than originally believed, and the more we look, the more we find. The primary mode for spread of infestation is human movement of infested firewood into non-infested areas. Thus, this issue could be preventable with cooperation by the public, businesses and government.
D. The Wisconsin Cooperative EAB Program is aware of current developments in EAB management and reduction in ash mortality and is making these new techniques available to the public, businesses, tribes, communities and landowners of Wisconsin.
E. The Wisconsin EAB Program is one in which stakeholders and state and federal agencies are fully cooperative and mutually supportive in our efforts to

achieve the objectives of the program and the best outcomes for the residents and forests of Wisconsin.

IV. Background

EAB is native to western Asia and appears to have been introduced in solid wood packing material to the Detroit, Michigan area sometime in the early to mid 1990's. The beetle went unnoticed for many years; EAB is small, ash often don't show symptoms in the first years they are infested, and many ash in the Detroit area were in poor heath for other reasons. EAB was finally recognized in 2002 when the borer started causing widespread death of ash in the Detroit area and across the Canadian border in Windsor, Ontario. Quarantines on nursery stock, logs, firewood and other potential vectors of EAB were instituted but EAB had already become established in many areas in the upper Midwest. It became just a matter of time before they were detected given our relatively rudimentary survey and detection tools for this species. Eradication has not been successful, probably due to the fact that populations are well established by the time they are detected. In Wisconsin, infestations dated dendrochronologically appear to have been established for at least four years before being detected. Given this situation, it is likely that we will continue to discover infestations of EAB in Wisconsin which were introduced years ago. We may also have difficulty realizing the effects of containment efforts for several years due to this delay in detection.

Where EAB has become established, it has killed nearly all ash trees present. White and green ashes make up a large proportion of urban trees in Wisconsin, as they did in Michigan, and we can expect similar levels of losses. Black and green ash are dominant trees in Wisconsin's lowland and wet forests and the loss of these species can be expected to have significant ecological effects including flooding or water table fluxuation. Loss of black ash is of cultural significance to Native American communities in the Great lakes region.

Efforts to slow the spread of EAB are important for Wisconsin communities and forests for two reasons. The first is that it buys time while new management options are developed. In its native land, EAB has not been considered an important pest, so no pre-existing detection or management tools were available when it was first recognized as a threat in North America. However, development of detection and management options has been rapid since then. As with other invasive pests such as the gypsy moth, we can expect further progress with improving control options. Every year we can keep EAB out of a community or forest we have a chance of further reducing losses from it when it does become established. The second reason is that retarding the spread of EAB also allows more time for communities and landowners to do preparatory work to minimize the losses from this pest and to spread the cost of this work over several budget cycles.

V. Objectives and Strategies

The following list of objectives and strategies is not presented in order of priority. All are deemed appropriate in their own right. Strategies chosen for implementation will be based on availability of funding or other resources.

Objective A: Prevent or retard the spread of EAB in Wisconsin. While EAB adults can fly, they typically don't go far, which slows the natural spread of a population. Models have shown that if the spread of EAB had been limited to its natural ability, Wisconsin would not be at risk today from this pest. However, EAB life stages can be moved long distances in or on various articles including nursery stock, logs and firewood which are how the pest has been able to spread over such a large area in such a short time. Stopping or minimizing this movement should slow the beetle's ability to colonize locations distant from the area of general establishment. Impeding spread of EAB will delay economic and ecological impacts and provide time for development of new tools for managing EAB and the damage it causes.

Strategy 1: Minimize artificial movement of EAB to non-infested areas.

Tools and Options

a. Regulation of movement of potentially EAB infested material.
    i. Quarantines: federal and state.
    ii. Regulation of firewood allowed onto public lands.
    iii. Provide guidance on effective local ordinances.
b. Support options for firewood which are less likely to contribute to introductions of EAB.
    i. Provide a state certified firewood program for dealers wanting to treat their wood but who may not be within EAB quarantine areas.
    ii. Connect public with local or state certified sources of firewood.
    iii. Develop guidance to reduce risk of transmitting wood borne pests and diseases for non-commercial firewood cutters.
c. Educate the public on actions that decrease the risk of introduction of EAB.

Strategy 2: Minimize natural spread of established populations. This strategy will be more important to pursue with populations that are thought to be isolated and in human population centers than those which appear to be part of a contiguous population or in rural areas (Siegert 2011).

Tools and Options

a. See Appendix 5: Current Options and Considerations for Management of EAB.

Objective B: Prepare community and rural forests for infestation by EAB to reduce economic and ecological losses and improve future resilience to pests and other stresses. A variety of management actions can be started well before EAB arrives in an area that can mitigate the eventual impact of the pest. Even where eventual losses from EAB cannot be avoided, it may be possible to spread the cost of these losses over a longer period of time avoiding severe and acute economic impacts.

Strategy 1: Encourage and support communities taking proactive steps to mitigate impacts of EAB.

Tools and Options

a. Develop guidance on management options for communities.
b. Ensure communities are aware of potential benefits of spreading actions and thus costs of mitigation, removal and recovery and the models that can help them make decisions.
c. Ensure communities are aware of funding assistance available for proactive work.
d. Provide training opportunities for local government staff on improved detection techniques and management options.

Strategy 2: Encourage and guide woodlot owners on actions to reduce losses and improve resilience of their forests.

Tools and Options

a. Provide silvicultural guidance on managing forests now that EAB is present in the state.
b. Develop options consistent with the Managed Forest Law for woodlots impacted by EAB.

Objective C: Detect new populations of EAB and monitor known populations and damage caused. Earlier detection of populations of EAB often allows a greater range of management options than detections when a population is well established and spread over a wide area. Formalized surveys conducted by state, federal, Native American and other public entities can be supplemented by awareness of what to look for and who to contact by those in professions where they are likely to encounter infested materials. Increase general public's awareness of EAB.

Strategy 1: Develop a coordinated, risk-based survey program that targets areas most likely for EAB introduction.

Strategy 2: Advocate to the USDA for urban Forest Inventory Analysis to assist in early detection of EAB and other invasive pests.

Strategy 3: Supplement formal surveys with other means of detecting EAB.

Tools and Options

a. Train tree care professionals, nursery managers, campground owners, master gardeners and others who encounter potentially infested materials on the signs of EAB and who to contact in the case they find a suspect item.
b. Support a reporting hotline and website support materials to facilitate reporting by professionals and the public.
c. Develop a volunteer first detector program.

Strategy 4: Identify the extent of separate EAB populations where this information is useful for management or regulation purposes at the state or local level.

Strategy 5: Map tree mortality from EAB as part of normal forest health surveys.

Objective D. Manage EAB populations and/or the damage and losses caused by them. Few tools are currently available to directly affect EAB populations except on an individual tree basis. Minimizing economic and ecological losses is possible through improved arborcultural and silvicultural actions.

Strategy 1. Educate communities and landowners on options to preserve individual, high value ash trees through long term use of pesticides.

Tools and Options

a. See Appendix 5: Current Options and Considerations for Management of EAB.
b. Insecticide Options for Protecting Ash Trees from EAB https://onlineservices.datcp.wi.gov/eab/articleassets/InsecticideOptionsForProtectingTreesFromEAB.pdf

Strategy 2. Provide guidance to communities and woodlot owners on management of their ash resource.

Tools and Options

a. Promote the use of the guide to urban ash management.
b. Promote the use of silviculture recommendations for ash management in woodlots infested with EAB.

Strategy 3. Ensure loggers and private foresters are aware of economic opportunities resulting from trees killed by EAB.

Strategy 4. Include biological control as a management option.

a. Assess and introduce appropriate biological controls of EAB.

b. Participate in studies of factors affecting their establishment and impact.

c. Advocate that federal agencies continue efforts to identify additional candidate biological control species, test them for specificity and suitability to North American conditions, and develop rearing programs.

Objective E. Encourage utilization of ash wood as appropriate.
Management of EAB can involve the destruction of significant numbers of ash trees (both infested and non-infested). Large numbers of trees may have to be processed at once, for example where a community is infested and a large number of trees are dying concurrently. Or there may be a steady but lower stream of trees, for example, where a community is reducing the number of ash prior to establishment of EAB. As a result, one of the largest challenges in EAB management projects is the disposal or utilization of ash material, especially in residential areas.

Strategy 1: Develop and test practicality of new options for harvesting in urban or suburban situations and for utilizing the produced wood.

Strategy 2: Assist landowners and communities in developing group contracts for ash removal and processing.

Strategy 3: Work with industry to expand uses of ash in both existing and new markets

Objective F. Rehabilitate, facilitate and guide restoration of sustainable ecosystems following loss of ash trees. Ash species constitute a significant component of urban and rural forests in Wisconsin. To maintain the functions and services these forests provide, it will be necessary to replace ash lost to EAB. In the long term, it may be possible to develop strains of native ash species that are resistant to EAB and reintroduce them to the state.

Strategy 1: Identify potential replacement species for ash in urban and rural landscapes.

Strategy 2: Collect and conserve seed from a variety of populations of each ash species found in Wisconsin.

Strategy 3: Identify remnant ash in EAB infested areas that may be tolerant or resistant to EAB and make them available to tree improvement programs.

Strategy 4: Advocate for genetic improvement programs for ash species.

Objective G. Communicate roles and responsibilities of EAB Program participants to both participants and public. For this complex program to work most efficiently, it is necessary that participants understand their own and others roles in the organization. The public must also be aware who they should contact to get help with the variety of issues handled within the EAB program, from traps on private property to advice on managing wood from killed trees.

Strategy 1: Provide participants with overview of the Cooperative Program.

Strategy 2: Provide guidance to Response Units dealing with immediate local needs following identification of a new population of EAB.

Strategy 3: Provide direction to the public on key participants, their areas of responsibility and how to contact them.

Objective H. Seek funding to support state and local efforts for survey, regulation, management, research, and educational activities to minimize EAB impact on the forests and the people of Wisconsin. Funding is an important factor determining the actions that can be taken against EAB.

Strategy 1: For projects proposed for implementation in the annual activity plan, determine the monetary and personnel needs and apply to appropriate federal, state or other sources for funding and/or resources and staff time.

Strategy 2: Identify key stakeholders and partners to help implement this strategy and the planned management activities. Identify opportunities to utilize both public and private funding sources to maximize plan implementation.

Objective I. Ensure the public is aware of actions and results of the EAB program and how these benefit Wisconsin landowners, communities and forests. If the program is successful in minimizing impacts of EAB, it may not be obvious that this result is due to hard work and expense. This misunderstanding could jeopardize continued support for these efforts.

Strategy 1. Provide information to the public on the state's survey, detection, regulatory and management activities and results and what these mean for them. Make clear the financial benefits of this work to the public.

Strategy 2. Ensure the public is aware of the cooperative program's efforts to make the most recent advances in delimitation and management options available to communities and individuals.

Strategy 3. Refer to activities and results as those of the WI EAB Cooperative Program and not just that of a single agency.

VI. Appendices

Appendix 1: Measures of Success 2008-2013
Appendix 2: Wisconsin Cooperative EAB Program
Appendix 3: Applicable Laws, Statutes and Administrative Rules
Appendix 4: Options for Detection, Delimitation and Monitoring of EAB Populations.
Appendix 5: Current Options and Considerations for Management of EAB.
Appendix 6: Communication Structures and Tools
References used in development of plan and appendices

Appendix 1: Measures of Success for Desired Outcomes, 2014-2019

Objective A: Prevent additional introductions or retard the spread of EAB in Wisconsin.

- Strategy 1: Minimize artificial movement of EAB to non-infested areas.
    - Regulation of movement of potentially EAB infested material
        - DATCP declares a county level quarantine as soon as practical after the discovery of EAB in a previously uninfested county.
        - APHIS declares a county level quarantine within 3 months of discovery of EAB in a previously uninfested county.
        - DNR shows increasing compliance with firewood regulation on state lands through a survey of camper behavior that is repeated every two years.
        - DNR Urban Forestry staff developed template of local nuisance tree ordinance (not species or pest specific) and distribute.
        - Record grant assistance given by DNR Urban Forestry staff to communities.
    - Support options for firewood which are less likely to contribute to introductions of EAB.
        - DATCP offers affordable, yearly state certification for firewood vendors who treat their wood to state determined standards.
        - DNR develops reasonable precautions to reduce risk of transmitting EAB for non-commercial firewood cutters and disseminates this guidance on the department website and at educational opportunities.
        - Facilitate the development of a website where customers could search for local or DATCP certified firewood vendors
    - Educate the public on actions that decrease the risk of introduction of EAB.
        - Using a repeated survey, measure public awareness of actions that help and hinder the spread EAB.
        - Develop and disseminate awareness and educational material on EAB identification, signs of infestation, firewood quarantines and other regulation, and associated topics.
- Strategy 2: Minimize natural spread of established populations of EAB.
    - Educate community and property managers on the effect some management tools have on natural spread by EAB and encourage their use where they are also appropriate for the goals of the community or property.

Objective B: Prepare community and rural forests for infestation by EAB to reduce economic and ecological losses and improve future resilience to pests and other stresses.

- Strategy 1. Encourage and support communities taking proactive steps to mitigate impacts of EAB.
    - Maintain Guide to Urban Ash Management.
    - DNR Urban Forestry Program awards grants to communities for projects including preparing for or responding to EAB. (To see a list of projects awarded each year, go to http://dnr.wi.gov/forestry/uf/grants/index.htm .)
- Strategy 2. Encourage and guide woodlot owners on actions to reduce losses and improve resilience of their forests
    - Keep current guidance on silviculture for woodlots threatened or infested with EAB.

Objective C. Detect new populations of EAB and monitor known populations and damage caused.

- Strategy 1. Develop a coordinated, risk-based survey program that targets areas most likely for EAB introduction.
    - A yearly detection plan for EAB including grid trapping and high risk locations is developed and implemented in cooperation with DATCP, APHIS, DNR and Tribes.
    - Contribute trapping data to the Forest Service to help improve risk model for placement of traps to detect EAB.
- Strategy 2. Advocate to the USDA for urban Forest Inventory Analysis to assist in early detection of EAB and other invasive pests.
    -
    - Participate in urban Forest Inventory Analysis
- Strategy 3. Supplement formal surveys with other means of detecting EAB.
    - Staff EAB reporting line; maintain web reporting site and guidance at cooperative website http://www.emeraldashborer.wi.gov.
    - UW Extension develops a volunteer first detector program to assist in confirmation of EAB in quarantined counties.
    - APHIS will collect agrilus beetles from Cerceris plenipennis colonies and report any recoveries of EAB in counties or municipalities where it has not yet been recorded.
- Strategy 4. Delimit or train cooperators to delimit EAB populations where this information is useful for management or regulation purposes at the state or local level.
    - Delimitation is done where the information will be used for management or regulation.
- Strategy 5. Delimit tree mortality from EAB as part of normal forest health surveys.

- Tree mortality is aerially mapped by DNR forest health staff when it occurs. These data and maps are reported yearly to the Forest Service.

Objective D: Manage EAB populations and/or the damage and losses caused by them.

- Strategy 1. Educate communities and landowners on options to preserve individual, high value ash trees through long term use of pesticides.
  - Guide is kept current on the use of pesticides to preserve ash. Guide is posted on the cooperative EAB website and workshops and presentations on the topic given.
- Strategy 2. Provide guidance to communities and woodlot owners on management of their ash resource.
  - Develop, distribute and electronically post guides to urban ash management and silviculture for woodlots infested with EAB. Give presentations on this information at meetings of community foresters and woodlot owners.
  - Track how many communities are undertaking ash management projects.
- Strategy 3. Ensure loggers and private foresters are aware of economic opportunities resulting from tree mortality caused by EAB.
  - Include information on potential economic opportunities from EAB in training provided to loggers and private foresters.
  - Track whether economic opportunities are being realized. If there are not, determine impediments.
- Strategy 4. Introduce biological controls of EAB.
  - Assess potential sites for introduction of biological controls.
  - Assess new federally approved candidate species for introduction into WI.
  - Introduce selected biological controls for EAB.
  - Demonstrate establishment of biological controls for EAB.
  - Determine factors affecting successful establishment of biological controls for EAB.
  - Participate in measurement of impacts of biological controls on EAB population growth.

Objective E: Utilize ash wood as appropriate and decided by stakeholders.

- Strategy 1. Develop and test practicality of new options for harvesting in urban or suburban situations and for utilizing the produced wood.
  - Conduct outreach to communities to make them aware of this mechanized harvesting for management of tree mortality from EAB.
  - Continue to explore new options for harvesting ash in the urban landscape and utilizing these trees to reduce costs of management for communities.

    - Determine needs of wood utilizers and communities and explore regulatory alternatives that may be able to allow satisfaction of these needs.
- Strategy 2. Assist landowners and communities in developing group contracts for ash removal and processing.
    -
    - Assist in educational workshops on ash utilization at the local level.
    - Provide technical assistance to counties and communities planning urban wood utilization

Objective F. Rehabilitate, facilitate and guide restoration of sustainable ecosystems following loss of ash trees.

- Strategy 1. Identify potential replacement species for ash in urban and rural landscapes.
    -
    - Increase awareness of the variety of replacement species for ash in urban and rural landscapes by the public, communities and industry.
    - Every 5 years, maintain and expand as appropriate the list of replacement species for ash for Wisconsin by UW Extension.
- Strategy 2. Collect and conserve seed from a variety of populations of each ash species found in Wisconsin.
    - Review existing ash seed conservation efforts.
    - Select a program that best meets WI anticipated needs.
    - Collect and conserve seed from a variety of populations of each ash species found in Wisconsin and contribute to the selected program
- Strategy 3. Identify remnant ash in EAB infested areas that may be tolerant or resistant to EAB and make them available to tree improvement programs.
    - Once ash mortality becomes widespread enough for remnant survivors to be noticeable, develop a public awareness campaign for arborists, community and private foresters, and state agency staff to alert them to the potential existence of EAB tolerant individual trees and how and to whom to report such candidates for propagation.
- Strategy 4. Advocate for genetic improvement programs for ash species.
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    - Advocate for federal and state support of identification of resistant or tolerant ash and participate in propagation of such stock.
    - Chief State Forester and Forest Health program advocates to USDA Forest Service for support of ash improvement programs

Objective G. Communicate roles and responsibilities of EAB Program participants to participants and public

- Strategy 1. Provide participants with overview of the Cooperative Program.
    - Appendix B of this document gives participants an overview of the Cooperative Program.
- Strategy 3. Provide direction to the public on key participants, their areas of responsibility and how to contact them.
    - Keep updated a list of key participants in the EAB program, their area of responsibility and contact information and make it available to participants and the public.

Objective H: Seek funding to support state and local efforts for survey, management, regulation, research, and educational activities to minimize EAB impact on the forests and the people of Wisconsin.

- Strategy 1: For projects proposed for implementation in the Annual Wisconsin EAB Response Activities and Program Strategies document, determine the monetary and personnel needs and apply to appropriate federal, state or other sources for funding and/or resources and staff time.
    - In annual activity plan, identify funding, staff time and other resource needs for each project proposed for implementation.
    - Using the list produced, approach federal, state, Tribal, municipal and other cooperators to secure necessary funding and resources.
- Strategy 2: Identify key stakeholders and partners to help implement the state's strategy and planned management activities, and how funding affects what can be done.
    - For each issue or project proposed for implementation in the yearly plan, list key stakeholders.
    - Approach these stakeholders, educate them on activities planned that could affect them and recruit them as cooperators in achieving these projects. Include the stakeholders approached and their response in reports on activity progress.
    - Provide guidance on resources available to increase plan implementation

Objective I. The public is aware of results of the EAB program and how these benefit Wisconsin landowners, communities and forests.

- Strategy 1. Provide information to the public on the state's survey, detection, regulatory, and management activities and results and what these mean for them.
    - Utilize existing and establish new relationships with news media to ensure information reaches the public on results of state survey, regulatory, and management efforts and how these affect them.
    - Establish partnerships and work with partners to deliver program messages. Partners include, but are not limited to; campground owners, municipalities, Wisconsin Tribal Government, educators, and recreational groups.

    - Identify audiences that could benefit from education on EAB and associated topics such as firewood movement.
- Strategy 2. Ensure the public is aware of the cooperative program's efforts to make the most recent advances in delimitation, regulatory and management options available to communities and individuals.
    - Include outreach to the public as part of the notification process for training on new techniques for use by communities and individuals.

Appendix B - Wisconsin Cooperative EAB Program

A. Organization of the Cooperative EAB Program

DATCP and DNR developed the Emerald Ash Borer (EAB) Program structure chart (Figure 3) in consultation with USDA-APHIS, USDA-FS and the University of Wisconsin. The chart reflects the need for coordinated leadership on EAB, consultation with partners, extensive outreach and education, and development of Wisconsin-specific science. It shows how DNR and DATCP will work cooperatively with each other, partners and key stakeholders to implement Wisconsin's EAB program

An interagency **Advisory Group** that includes managers at DATCP, DNR and representatives from the University of Wisconsin-Madison, the University of Wisconsin-Extension, the USDA-APHIS, and the USDA-FS will provide oversight of and direction to Wisconsin's EAB program. The Advisory Group will advise the Governor, state agency senior management and working groups on state policy, seek funding, develop strategic plans for EAB program activities and response, sponsor and set working group goals, and resolve conflicts. The Advisory Group will also be the state's formal conduit to the National EAB Management Team and the National EAB Science Advisory Panel. The Advisory Group will review the program structure annually, or more often if necessary, to ensure Wisconsin's EAB program is efficient and effective.

Each member of the Advisory Group is assigned as a liaison to one or more key partner or stakeholder groups. He or she is responsible for keeping them informed about EAB program direction and issues, engaging them in program activities to the extent the partner or stakeholder group is comfortable and receiving feedback to be discussed and resolved by the Advisory Group, if needed.

DNR, DATCP, USDA-APHIS and Forest Service are in ongoing discussions with Wisconsin's tribal nations to determine their role in Wisconsin's EAB program activities and are committed to including the tribal nations as full partners in the EAB program and as members of the working groups as appropriate. Some working groups currently have or have had Tribal representatives.

The Advisory Group sponsors three working groups: Outreach and Communications, Operations, and the Wisconsin Science Panel. Working groups determine their own membership and representation that includes, at a minimum, staff from both DNR and DATCP. The working groups bring in additional expertise as needed for consultation. Each working group reports to the Advisory Group on their activities.

The **Outreach and Communications** group guides EAB-related strategic and incident communications, develops general EAB outreach materials and

messages, designs and implements EAB media campaigns, and identifies key stakeholders and core recipients for EAB outreach.

The **Operations** group implements policy as determined by the Advisory Group, develops and implements and makes recommendations on regulatory actions and quarantines for EAB, coordinates responses to early EAB establishment and develops and implements long-term EAB management strategies. The Operations Group will also coordinate efforts with other appropriate groups, civil units, tribes, and individuals as needed to achieve the goals of the program, as determined by the Advisory Group.

The Operations Group is the body which will determine which EAB populations will be responded to and will define the limits for the goal(s) for that response. Local Response Units will develop immediate (within one year), local response goals to their populations within those limits. The Operations Group will review and offer advice to the Response Units on action strategies and pursue additional resources to achieve local goals as appropriate.

The **Science Panel** provides scientific information and advice for program decisions, identifies the science information needs of the program, reviews existing research and identifies potential new research projects. The Science Panel is indirectly connected to the National EAB Science Advisory Panel.

B. Participating Agencies

The WI Cooperative EAB Program is made up of representatives from the following state and federal agencies: Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP); Wisconsin Department of Natural Resources (DNR); USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA-APHIS); USDA Forest Service, State and Private Forestry (USDA-FS), the University of Wisconsin-Madison (UW) and the University of Wisconsin-Extension (UWEx).

DATCP and DNR have a formal relationship described in the attached Letter of Agreement. These two state agencies established the Cooperative Program and adopted the Letter of Agreement to integrate their legal, programmatic, scientific and field operations to address the EAB threat.

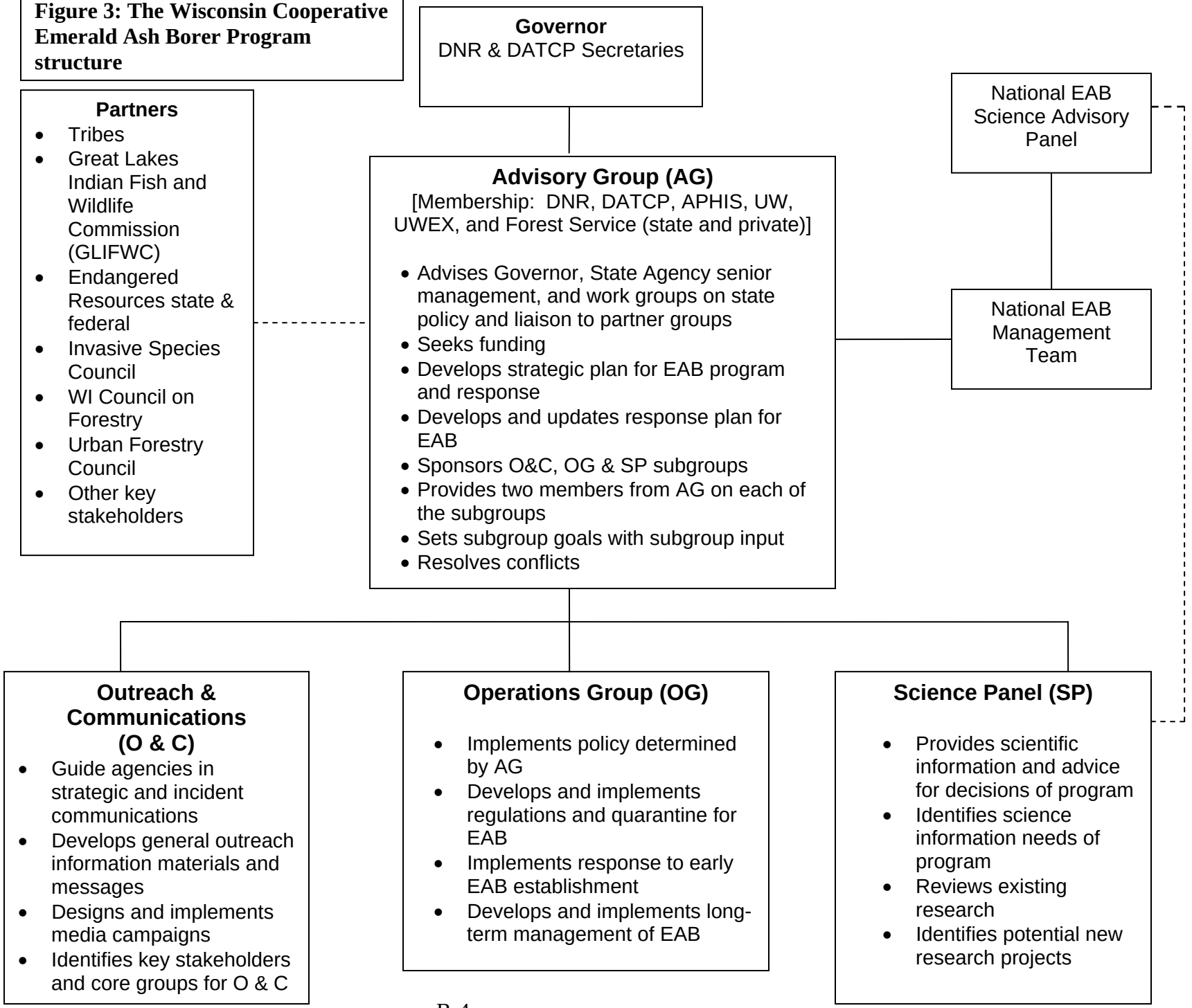
C. Agency Responsibilities Based on Authorities

Each group listed in the following chart has responsibilities that are based on federal law, state statute or administrative rule. Responsibilities that apply to EAB are listed here. Some activities are agency specific, while others are shared across agencies. Moreover, one agency may have the authority for specific actions, but another agency may, at times, have the resources to conduct the work more efficiently. A Memorandum of Understanding (MOU) between DNR and DATCP helps to sort out overlapping duties.

The following chart applies to private and public lands. Lands that are generally NOT covered here include federal and tribal land. Federal lands are specifically the responsibility of federal agencies, though DATCP may work on federal lands under a cooperative agreement. Each tribal government has the autonomy to determine its own plan of action on its land. Work remains to engage the federal landowners and each tribe's representatives to determine whether, or how, they would like to proceed on EAB activities.

	Detection	Regulation	Control	Communication
USDA – APHIS	Technical support and funding. Official identification.	Quarantine. Interstate movement. Emergency action notification. Compliance agreement.	Assist with containment.	Participate in activities with other agencies and affected groups. Printed materials.
USDA- FS National Forest System		Restriction of movement of firewood onto national forest land.	May assist with implementation.	
USDA-FS State and Private Forestry	On all federally owned land. Technical support and funding. May now be APHIS		Assist with management.	Participate in activities with other agencies and affected groups. Printed materials.
DATCP	On all properties, private and public.	Quarantine. Intrastate movement. Holding and destruction orders.	Delimitation survey. Control and containment. Contracting services.	Notify and coordinate activities with other agencies and affected groups. Press releases and other printed materials.
DNR	On non-federal forest lands. This excludes urban forests, which will be coordinated by DATCP.	On land owned or managed by DNR, they may regulate users, including their use and possession of firewood.	Development of management recommendations in cooperation with other state and federal agencies.	Coordinate activities with other agencies and affected groups. Press releases and other printed materials.
Univ. of Wisconsin	On university property and other by permission.			Printed materials and established professional networks in counties and communities

Figure 3: The Wisconsin Cooperative Emerald Ash Borer Program structure



Appendix C - Applicable laws, Statutes or Administrative Rules

Federal Regulations
Plant Pest Act 2000
7CFR 301.53 – 301.53-9 - EAB regulations
7CFR 319.40 - Solid wood packing material

Wisconsin State Statutes
23.11 - General Powers
23.22 - Invasive Species
23.09(2)(h) - Conservation Cooperation
26.30 - Forest insects and diseases, department jurisdiction and procedure
26.97 - Law enforcement and police power
93.06(11) - Interagency Cooperation
94.01 - Plant inspection and pest control authority
94.02 - Abatement of pests
94.03 - Shipment of pests and biological control agents permits
94.10 - Nursery stock, inspection and licensing
94.46 - Stop sale, penalties, enforcement
94.67-94.715 - Wisconsin Pesticide Law

Wisconsin Administrative rules
ATCP 21 - Plant Inspection and Pest Control.
ATCP 21.17 - Emerald ash borer; import controls and quarantine
ATCP 21.20 - Relating to Voluntary Certification of Firewood Dealers
NR 35 - Zones of Infestation of Forest Pests
NR 45 - Use of Department Properties
NR 45.04(1)(g) - Regulation of firewood entering Department of Natural Resources lands

DATCP has developed two rules which have become law. Both are under ATCP 21 Plant Inspection and Pest Control. The first rule establishes import controls on plants, plant products, soils or other materials that are likely to harbor pests such as emerald ash borer, sudden oak death and Asian longhorned beetles. The second, ATCP 21.20 Relating to Voluntary Certification of Firewood Dealers, allows for certification of firewood dealers and allows for the movement of non-infested firewood. Additionally, DNR developed a rule, NR 45.04(1)(g) Firewood Management on State Lands, that states firewood that is certified by DATCP or originates within 25 miles of the campground but is not from out of state or from an EAB quarantined area if the property is not within that area is allowed onto DNR-managed properties.

Appendix D - Options for Detection and Delimitation of EAB Populations

1. Formal Surveys
2. Informal Surveys
3. Verification of Potential Finds of EAB in Un-Infested Areas
4. Delimitation of Detected Infestations
5. Data Management

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Considerations

- Early detection and monitoring surveys should both be implemented as part of a rigorous survey program. Early detection activities should focus on areas where risk factors are high for introduction. Monitoring activities should focus on the spread and impact of EAB populations and effectiveness of management actions.
- Survey technique should be selected based on what purpose the information collected will be used.

Tools and Options

1. Formal surveys

Goal: Develop a coordinated, risk-based survey program that targets the areas most likely for EAB introduction.

a. DATCP has developed and ground truthed a Wisconsin risk-based model that is used annually to identify locations where risk of introduction is greatest.
b. Girdled living ash trees are attractive to adult EAB for egg laying. Therefore, girdled detection trees can be monitored for EAB adult visitation and later cut and peeled to survey for evidence of EAB presence. Trees selected for girdling should be open grown and well exposed to the sun if possible.
c. Ungirdled ash trees may also be felled, peeled and examined for the presence of EAB as part of a survey. Trees that are in areas at high risk for introduction of EAB but where girdling is not possible, in proximity to known infested trees, or are showing signs or symptoms of possible infestation by EAB are best candidates for peeling and inspection without prior girdling.
d. Sampling of ash branches can also be used to detect infestation by EAB. Ryall et al. (2010) developed a sampling protocol for urban settings where short sections of two branches of specific size are peeled and examined for larvae or signs of infestation. This method is faster than whole tree sampling, very sensitive, can provide

quantitative results, and as it does not kill the tree is more acceptable to the public and can be repeated in future years.

e. Prism traps, baited with chemical blends that mimic ash volatiles and colored purple or green to attract EAB adults, are currently available. The traps are covered with a sticky glue-like substance that captures insects attracted to the trap and bait. Traps can be used in a grid or risk-based survey. Efficacy of the trap is a combination of color, scent or scents used and location. The most effective combination appears to be a double-decker trap mounted on a pole with a leaf volatile mimic on the top trap and a bark volatile on the lower trap placed in the open. This type of trap is relatively expensive however, and trapping programs usually select one combination of color and scent.

f. Methods for using the solitary wasp, *Cerceris fumipennis*, in biosurveillance for EAB are being developed. Female wasps capture adult Buprestids within 2 km of their nest to provision their larvae. By collecting the Buprestid prey as the wasps return to their nests, a survey can be made of the Buprestids, including EAB, within a radius of 2 km.

Goal: Delimit infestations

a. Whole tree sampling can be used to delimit a population but it is time consuming, expensive and destructive.
b. Traps can also be used to delimit a population but they are not very sensitive and because they catch adults, it may be difficult to pinpoint the actual location of the infested trees.
c. Sampling branches (Ryall et al. 2010) is the most promising technique for delimiting populations. It has only been tested in urban settings so far but the information gained has been used by community forestry staff to guide management.

2. Informal surveys

Goal: Supplement formal surveys with other means of detecting EAB.

a. Foresters, arborists, nursery managers, campground managers, master gardeners and others can be a critical part of the survey effort as these individuals work directly with the ash resource on a regular basis. First detectors trained to recognize EAB may also play a role.
b. Use of tools such as the EAB hotline, Web site and a formalized reporting and follow-up system will expand the potential for early detection of EAB.

3. Verification of Potential Finds of EAB in Uninfested Areas

There are a number of ways in which emerald ash borer may be discovered. It may be noticed by municipal or nursery personnel, a homeowner, or as part of a survey. Regardless of who makes the discovery, the first find in an uninfested county must be confirmed by Dr. Jim Zablotny at the Michigan SPHd's office or by a specialist with WI DATCP. Subsequent specimens may be confirmed by entomologists at the UW-Madison, DNR, DATCP, USDA-Forest Service or USDA-APHIS-PPQ.

4. Data Management

Whether it is a visual survey for prospective detection trees, peeling a tree for signs of infestation, monitoring attractant-baited traps, or collecting beetles from *Cerceris fumipennis*, field personnel collect predetermined data as part of Wisconsin DATCP's ongoing EAB survey effort. Data captured during these efforts consist of, but is not limited to, assignment of an unique identifier, detailed location descriptions, GPS coordinates, summary of the process being completed, date of process, land owner designation, cooperative agency information, sample collection data, and any additional comments deemed necessary for data clarification. Detailed records also assist other field staff to easily locate the specific site during future observations.

With the use of GPS data transfer software in combination with the completed paperwork, all of the gathered data is maintained in one Access database. Once in the database, work completion statistics can be summarized, additional forms and reports can be created, and data can easily be shared with other government agencies for a collaborative EAB survey effort. In addition, an annual survey report is also produced and distributed to USDA-APHIS.

All agencies in the state engaged in EAB detection and survey work; WI DNR, UW Extension, the Wisconsin Tribal Conservation Tribal Advisory Council, and USDA-Forest Service, collect similar data. At the conclusion of each survey season, data from all participating entities is consolidated by DATCP staff to show the complete effort to protect Wisconsin's ash resource.

Appendix E - Current Options and Considerations for Management of EAB.

A. Factors that Influence Feasibility of Management Goals

Making decisions related to the implementation of control options must include evaluation of the factors that influence feasibility of the goal.

1. **Age of infestation** – Older populations are more likely to have spread making accurate delimitation difficult. If delimitation is not accurate, eradication or affecting the rate of population spread is unlikely to be successful.
2. **Size of infestation** – The larger the population, the less likely eradication or even slowing the spread is to be successful.
3. **Ash density and distribution within and adjacent to infestation** – Host distribution can affect spread rate and direction as well as rate of population increase.
4. **Confidence in delimitation data** – Accurately delimiting a population of EAB is challenged by a lack of a highly attractive trap for adults and the difficulty in detecting larvae especially at low to moderate density where the host shows no signs of being infested. If delimitation is not accurate, eradication or affecting the rate of population spread is unlikely to be successful.
5. **Risk of reintroduction** Proximity to other infestations or a source of artificial introduction that cannot be stopped prevents or erases successful eradication. It is also likely to interfere with efforts to slow spread or population increase.
6. **Risk of artificial or natural spread <u>from</u> a location** – While this may have little effect on the success of management of a population, it does affect the urgency to address a particular population. This may result in efforts being made to control a population that otherwise would be a poor candidate for management.

B. Factors that Influence Selection of Management Technique

The following factors have been identified as important to analyze as part of the process for selecting a control option. The order of the factors is not significant. The influence of one may outweigh others and each infestation should be analyzed separately.

1. **Environmental impact**
2. **Land ownership**
3. **Land use or classification**
4. **Cost of implementing management**
5. **Availability of resources to carry out management**
6. **Sociological impact**
7. **Size of infestation**
8. **Traditional ecological knowledge**

C. Reduce the Rate of EAB Population Increase and Spread

1. Insecticide treatment to reduce EAB population and spread

Rationale

A variety of insecticides are available that target the larval and/or adult stages of EAB. These include both systemics and cover sprays. Currently available products (2011) are applied to individual trees; there are as yet no products that can provide control of EAB over wide areas as with aerially applied sprays.

Used over many trees in a stand or community, insecticides could suppress the pest population and theoretically reduce the rate of spread (Mercader et al. 2011). The optimal density and spatial distribution of pesticide treated trees in an infested stand to reduce spread has not yet been determined. Clustering treated trees near known infested trees would only have an effect so long as the EAB population was contained within the treatment area. Once some had established beyond the treated trees, the effect would likely be diminished. Scattering treated trees over a wider area could provide a reduction in spread for a longer period.

Insecticides may also be used to maintain ash in communities for limited periods in order to allow their gradual removal and replacement. In Wisconsin communities, ashes make up an average of about 20% of the trees. Death and removal of so many trees in a few years once EAB has arrived can devastate community budgets. Sudden loss of mature trees can also reduce property values and increase costs of cooling and water use for property owners. By treating mature ash with a persistent systemic, communities can retain the services of those trees for a few years, spread out the costs and impacts of removal, and gain some time for replacement trees to grow into the spaces left by the removed ash.

Considerations

- Use of pesticides on a large-scale (rural or urban forest) as opposed to individual tree management will require addressing issues such as environmental impact on a variety of ecosystems and objections to pesticide applications.
- Availability of effective registered products with an environmental assessment will influence options for chemical controls.
- Logistics for application may not be practical in non-urban settings.
- Cost of treatment should be compared with the benefits that can be expected by slowing spread of EAB or rate of tree mortality in making the decision on whether to treat. The EAB Cost Calculator (Cliff Sadof 2008) can provide guidance, (http://www.extension.entm.purdue.edu/treecomputer/)
- For guidance in selecting and using insecticides, see Insecticide Options for Protecting Ash Trees from Emerald Ash Borer (Herms et al, 2009) at http://emeraldashborer.wi.gov or www.emeraldashborer.info.
- Research on the use of insecticides to control EAB is in the early stages; more information is needed to understand the role insecticides may play in managing EAB in the long term.

Tools and Options

a. Systemic Insecticides

Use systemic insecticides (soil drench, trunk-injected or trunk-sprayed) to kill larvae, limiting emergence and subsequent dispersal of adult beetles.

i. There are an increasing number of products & application methods available; product effectiveness and costs of treatments vary.
ii. Once trees become infested, systemic insecticides may be less effective due to the tree's reduced ability to distribute the insecticide.

b. Cover Sprays

Kill newly hatched larvae on the bark, before they enter the tree and/or adult beetles as they feed on the foliage prior to dispersal and oviposition, limiting spread of the population.

i. Protective cover sprays must be timed precisely to be effective.
ii. Depending on the product, a wider number of non-target insects may be killed as spray is more widely dispersed than with a systemic treatment.
iii. Some products may have restrictions on where they can be applied, limiting broad-scale use over the landscape.

2. Attract EAB back into the infested area and kill.

Rationale

Girdled trees are consistently effective at attracting EAB when populations are at low to moderate densities. Girdled trees act as population "sinks" because EAB females preferentially oviposit on them. Insecticide treatment or removal and destruction of a girdled tree after oviposition eliminate the larvae in that tree.

Considerations

- Annual removal of sink trees will eliminate a portion of the EAB population. Whether that portion is enough to affect EAB density in the subsequent year will depend on EAB density, number and distribution of girdled trees and competition to attrach ovipositing females from other stressed ash trees.
- It is unknown whether or not attraction to sinks limits dispersal of EAB, though a model suggests it would be (Mercader et al. 2011).
- Lures are improving but are not yet effective enough for this application.
- Sinks could be used in combination with phloem reduction, insecticides or other strategies.
- Research data support preferential EAB attraction and oviposition on girdled trees but it's not yet clear what proportion of an EAB population can be removed using sinks.
- Preparation and management of sinks is time consuming and expensive.
- At high EAB densities, sinks will not work. There is no attraction because all ash are stressed (no differential attraction). At high densities, EAB compete for whatever ash phloem is available.

Tools and Options

a. Sinks

Use attraction of EAB adults to girdled trees to concentrate the next generation where it can then be destroyed. After beetles oviposit on the girdled trees, the trees are removed during the winter or early spring, eliminating a source of EAB. This should decrease the density of EAB and slow the spread.

i. Sink trees serve to identify infested trees that should be removed (versus unknown oviposition pattern).

ii. New sink trees should be established each year for several years to maintain attractiveness of center and reduce spread.
iii. Although some information is available, the optimal density and spatial distribution of sink trees has not been determined. Details outlining deployment of sinks would likely need to be done on a site-specific basis.
iv. If sink trees are merchantable, they could be utilized

b. Lethal Sink Trees

Minimize EAB dispersal out of a designated area, protect a designated area, or attract and kill the residual population of EAB as a follow-up to other management actions. Similar to sinks but these trees would be treated with an insecticide. Trees are trunk-injected then girdled roughly 3 weeks later (to allow for translocation of insecticide). Alternatively, trees could be girdled then sprayed with a topical insecticide application.

i. May be most appropriate to attract and kill a residual EAB infestation following selective harvest or other cutting activity or to protect a designated area. Specific trees could be left to serve as lethal trap trees or balled and burlapped ash trees (treated, girdled) could be brought in for this purpose.
ii. Could use trees for 2 years. The first year, trees could be lethal trap trees. The second year, they could serve as stressed sink trees that are removed during the winter.
iii. Treatment success could vary with tree size and the EAB population pressure. The optimal density & spatial distribution of lethal trap trees is unknown.

c. Combine Sinks and Lethal Trap Trees

Create sinks by girdling ash trees. Prior to girdling, treat ½ of the trees with an insecticide. Remove girdled, untreated trees during the winter. Allow girdled, treated trees to stand an additional year to serve as sinks and remove during the winter.

i. Costs would be lower than treating all trees.
ii. Should help to limit dispersal. Emerging beetles are attracted to foliage for feeding, but killed before they can oviposit or disperse.

d. Islands of Attraction

Combine sinks, lethal trap trees and phloem removal to create “islands of attraction” to attract and kill the residual population of EAB after eradication or other phloem removal activities.

3. Phloem Reduction

Rationale

Phloem tissue is the innermost layer of the bark and serves as the source of food for the larval stage of EAB. EAB, like other phloem-feeding insects, is primarily regulated by availability of phloem. Recent work raises concerns about whether this technique can be successful in reducing spread of an EAB population (Mercader et al. 2011, Taylor et al. 2010).

Considerations

- Research has indicated that population densities of EAB in an area can be decreased by reducing its food resource, phloem, through the harvest of ash trees (McCullough and Siegert 2007).

- Simply reducing the amount of phloem in an area may not reduce the radial spread or population size beyond the thinned area (Mercader et al. 2011). If adult beetles can fly beyond the area of reduced phloem, they can establish satellite populations unaffected by the removal of phloem.
- Taylor et al. (2010) found that mated females flew longer than unmated females or males suggesting that EAB females may be programmed to make dispersal flights after mating. They conclude that if this is the case, ash-free zones may only encourage gravid females to fly further in search of hosts. How much this effect accelerates natural spread would depend on how much the population was reduced initially, the mortality rate experienced by individuals that must fly further in search of hosts, and the survival and mating success of the dispersed progeny.
- It must be emphasized that reducing phloem availability will not prevent EAB from infesting remaining trees. Gandhi et al. (2007) found no relationship between EAB induced ash mortality and stand-level variables, including ash density, ash basal area, total basal area, total tree density and species diversity.

Tools and Options

a. Models to calculate the number of ash trees to remove to meet a phloem reduction target.

To assist land managers in determining how many ash trees should be harvested to meet phloem reduction targets, an ash reduction model has been developed by Michigan Technical University (www.ashmodel.org). Based on the number of trees-per-acre and the diameter class data, the model calculates ash tree phloem basal area (a good indicator of the relative amount of phloem available to EAB) based on tree size and canopy closure conditions. Outputs for the model include diameter limits for removal of either small or large ash trees. Management objectives that require the harvest of larger ash trees, with their greater phloem availability, will result in fewer harvested trees.

b. Selective harvest

i. Infested Ash Tree Removal

Remove or destroy ash trees with symptoms of EAB infestation or otherwise known to be infested with EAB. This would eliminate a portion of the EAB population if done after ovipostion but before adult emergence.

ii. Large Ash Tree Removal

Phloem reduction will decrease the number of EAB that can be produced in a specific area but will not necessarily prevent EAB from infesting remaining trees; lower EAB density is equated to slower EAB spread. Large ash trees produce many more EAB than smaller trees.

a) Large ash are typically much less abundant than small ash trees (e.g. only 5-6% of all ash trees at 3 Michigan outlier sites were 10” in diameter at breast height (DBH) or larger).
b) Trees ≥ 10” DBH are merchantable and could interest timber buyers or other value-added producers, providing money back to landowners.
c) Large trees are generally more difficult to successfully treat with insecticides than smaller trees.
d) Need to consider post-harvest regeneration.
e) Models have been developed to estimate area of phloem removed or retained and number of EAB that will be produced under different scenarios. Models provide a means to compare alternative options and justify actions.

iii. Cut and Leave

Felling trees but leaving them on site is more efficient than felling and removing trees. Most late instar or prepupal EAB already developing in trees will likely emerge from felled trees. The felled trees no longer serve as brood material, however, so EAB density builds more slowly and spread rate slows.

a) Requires access to trees; felling trees may be a problem in wet areas, ecologically sensitive or culturally significant sites.
b) Can combine this with other options. For example, merchantable ash trees are harvested and removed first leaving only small ash trees to be felled. No effort would be made to remove or destroy small trees or logging slash.
c) Could combine with sink trees or lethal trap trees as defined later in the document under "attract and remove."

iv. Herbicides

Use registered herbicide to kill ash trees, reducing ash phloem. EAB larvae already developing in trees will likely emerge but dead trees will no longer serve as brood material. Population density builds more slowly and spread rate slows.

a) May be suitable in combination with other options such as sinks or large tree harvest.
b) Less damage to soil than felling trees, faster and more efficient.
c) Can be used where open water or topography limit access for tree felling.

D: Integrated Pest Management of Established Populations

1. Biological Control

Rationale

Management of EAB with specialist natural enemies may eventually be a valuable tool, especially in natural landscapes and woodlots where more intensive control methods are not practical. Introduction of specialist non-native parasitoids and diseases must wait, however, until the population of their host has become established in an area and is high enough to support the controlling species

Considerations

- Successful biological control programs have occurred on introduced pests in North American forests yet many biological control release programs have not resulted in noticeable control of the pest species.
- Three Asian species are currently (2011) available for introductions, *Oobius agrili*, *Spathius agrili* and *Tetrastichus planipennisi.* All have all been found to parasitize EAB in China at significant, though variable, levels. How they will perform in North America, however, remains to be seen.
- It is possible that it will be several years following introduction before we know if establishment has been successful and possibly many years before we can see effects on the EAB population.
- Release of biological control agents that are not native is regulated by USDA APHIS.
- Availability of biological control agents is affected by many factors, including program support for rearing the biological control agents.
- There is a possibility that some native natural enemies, perhaps those feeding on native *Agrilus* beetles, could switch hosts to include EAB. Some evidence for this exists, but to date the overall impact from these agents has been minimal.

- Future work includes evaluating the three species released to date, further foreign exploration for any additional natural enemies including insect pathogens, and monitoring native natural enemies and existing non-native species that could begin to utilize the very abundant EAB as a host.

Tools and Options

a. Release of biological control agents

Once EAB is established in Wisconsin, successfully introduce one or more biological control agents.

i. Candidate species for introduction will be assessed on the basis of several criteria including specificity, effectiveness, ability to survive in Wisconsin conditions and availability.

ii. In 2007, three non-native parasitoids were released in Michigan following several years of assessment of their specificity and development of rearing techniques. These species were *Oobius agrili* which attacks EAB eggs, *Spathius agrili* and *Tetrastichus planipennisi,* parasitoids of EAB larvae. Native parasitoids may also switch from their North American hosts onto EAB as it becomes abundant in their environment. This appears to have occurred in Michigan where in 2007 *Atanycolus hicoriae,* a native Braconid wasp, was found attacking EAB at a high rate. Since then, however, the parasitism rate from this native species has returned to low levels. At this time (2011), the available number of insects for release in the field is still fairly limited and so field releases are still being targeted to specific projects.

iii. Currently registered bioinsecticides (*Beauveria bassiana* and *Meterhizium anisopliae*) have been field and lab tested against EAB. Adult and larval mortality does occur, especially with *Beauveria*, but application problems exist, making field applications impractical at this time.

iv. Monitoring will be done to determine if introductions are successful, the effect on the EAB population by the introduced species, and the effect on native species by the introduced species.

v. The Wisconsin EAB program will encourage federal agencies to support further identification and development of potential biological controls for EAB in the upper Midwest.

2. Ash management

Rationale

The proportion of ash in an area will affect the ability of EAB to establish and spread within it and amount of damage the insect will do once established. An inventory to determine the amount of ash on a property or in a community is the first step in preparing for the pest and its impacts. If there is little or no ash, EAB may have difficulty establishing, success and rate of spread could be variable, but there is likely to be little to no effect on the local natural community. In contrast, an area that is heavily ash will favor establishment and spread and also be heavily impacted by the insect.

Considerations

- It is not necessary to cut all ash prior to EAB being found in the local area or even after it is established. Drastic reductions in the ash component can lead to ecological disruption, lowered income due to market flooding, and in residential areas difficulties removing the cut trees. Continue long-term management activities

using good forestry practices. Removing all of the ash prior to finding EAB is not recommended, as ash can continue to be a timber or ornamental tree and continue to provide benefits for wildlife.

- Currently, where EAB is long established nearly all individuals of all ash species are eliminated. If genetic diversity is to be maintained, collection of germplasm must be done prior to local extinction of locally adapted trees.
- Breeding for resistance in a tree species is a long-term goal that has taken in excess of 75 years for some species where it has been attempted (American Elm, American Chestnut)

Tools and Options

a. Silviculture and arborculture

If mortality from EAB would interfere with management goals for the property, forest landowners should reduce the proportion of ash in the woodlot during their next regularly-scheduled stand entry or entries. In woodlots, it is recommended that the ash component be reduced down to a level where the management objectives would not be compromised if all of the remaining ash were killed by EAB or harvested once EAB impacts the stand. A general rule of thumb is that a forest stand with less than 20% ash usually will not require any action. Favor non-ash species during management activities. For a more complete discussion of silvicultural options for woodland owners, see Emerald Ash Borer and Forest Management (2010) at http://dnr.wi.gov/forestry/FH/Ash/eab-management.htm

Tolerance for tree mortality is much less in urban forests than in rural woodlots but in partial compensation, there are a greater variety of tools and strategies that can be used to address it. For recommendations on managing ash in urban forests, see Urban Ash management guidelines at http://dnr.wi.gov/forestry/FH/Ash/eab-management.htm.

b. Breeding for Resistance

The State of Wisconsin currently has no initiatives with regards to tree breeding for Emerald Ash Borer resistance. Testing for resistance and potential genetic gains through breeding are unknown within the DNR.

c. Germplasm Preservation

Wisconsin is actively pursuing Ash seed preservation in cooperation with the National Seed Laboratory and National Center for Genetic Resource Preservation in Fort Collins, Colorado. Wisconsin DNR has developed a program for Ash seed collection, which is then processed and stored in Fort Collins, Colorado. The Tree Improvement program has developed a plan to collect 300 different seed lots from native ash trees across Wisconsin to ensure a supply of high quality seed for conservation and genetic research into the future.

3. Long term treatment with insecticides to maintain specimen trees

Rationale

Advances in pesticides for use against EAB now make long term preservation of specimen trees a practical option. Treating all ash in a community in perpetuity may not be a practical choice for many communities due to cost, ecological, and secondary injury concerns. However, evidence of persistence of protection for 2 or more years by some systemic insecticides may reduce costs to a point where wide scale treatment in urban situations becomes a cost competitive option (Sadof 2008, VanNatta 2010).

Considerations

- Preserving a tree using insecticides is a commitment for as long as EAB remains a threat in the area.
- When selecting an insecticide, take into account exposure of non-targets, potential for water contamination and other ecological considerations.
- Insecticides are not without risk to the tree. Injections cause wounding. Other pests may be released by effect of insecticides on natural enemies to cause their own harm to the tree (Sclar et al., 1998, Raupp et al. 2004). Managers should be aware of potential issues and take steps to prevent or mitigate secondary injury.
- For guidance in selecting and using insecticides, see Insecticide Options for Protecting Ash Trees from Emerald Ash Borer (Herms et al, 2009) at http://emeraldashborer.wi.gov or www.emeraldashborer.info.
- Research on the use of insecticides to control EAB is in the early stages; more information is needed to understand the role insecticides may play in managing EAB in the long term.

Tools and Options

c. Systemic Insecticides

Use systemic insecticides (soil drench, trunk-injected or trunk-sprayed) to kill larvae, preventing injury to treated tree.

i. There are an increasing number of products & application methods available; product effectiveness and costs of treatments vary.
ii. Treatments may not need to be done every year. Some systemic insecticides are showing protection persisting for two or more years.
iii. Once trees become infested, systemic insecticides may be less effective due to the tree's reduced ability to distribute the insecticide.

d. Cover Sprays

Kill newly hatched larvae on the bark, before they enter the tree and/or adult beetles as they feed on the foliage, before they oviposit, preventing injury to treated tree.

i. Protective cover sprays must be timed precisely to be effective.
ii. Depending on the product, a wider number of non-target insects may be killed as spray is more widely dispersed than with a systemic treatment.
iii. Some products may have restrictions on where they can be applied, limiting broad-scale use over the landscape.

E. Eradicate EAB population

Rationale

It is theoretically possible to eradicate isolated, small EAB populations. If eradication is successful, a local reproducing population is eliminated and the risk of spread out of that area will no longer exist.

Considerations

- Eradication has been attempted with recently introduced EAB populations in Maryland, Virginia and at Brimley State Park in the upper peninsula of Michigan. While initial results were encouraging, EAB was found again at these sites indicating eradication was not successful (Sargent et al. 2009). A significant challenge to successful eradication is our poor ability to fully delimit an EAB

population. Lightly infested trees on the perimeter may not be recognized and serve as a refugia from which the population can re-establish itself.

- Eradication is an expensive approach to an infestation. Delimitation must be intensive and over a wide area. Removal or pesticide treatment of all hosts is costly and can be controversial. Monitoring must be done for several years to be reasonably sure the population has been eradicated.
- In Wisconsin, eradication has been attempted only once. In that situation, a homeowner had transplanted two ash in August 2008 from an infested nursery in Illinois. This breach of quarantine was recognized that same fall and the infested trees removed and destroyed before any pupae within them were able to emerge. This was a unique situation where there was near certainty as to the identity of all infested trees. The possibility existed that a few adults could have emerged very late that summer when the trees were in Wisconsin and the site was monitored as a result. No EAB have been found at this site since the initial discovery.

Tools and Options

a. Complete host removal

Elimination of a localized population of EAB is achieved by removing and destroying all existing infested trees and potential host trees that could harbor undetected beetles. Seemingly healthy ash trees are removed because they may be infested but without obvious symptoms. Felled trees are typically chipped and/or burned. Stumps are removed and destroyed or treated with an herbicide to kill them, removing them as potential host material. Subsequent monitoring of eradication sites for EAB and re-growth of ash should occur for at least three years to determine the success of the eradication effort or the need for follow-up.

b. Combination of host removal and other tools

Elimination of a population of EAB is achieved by removing all existing infested trees and employing other tools that attract and destroy residual EAB. It should be noted that trees initially spared are typically girdled then cut and destroyed later after they have served to attract the remaining EAB in the area. Monitoring for at least three years is necessary to determine if eradication of EAB has been successful.

Appendix F - Communication Structures and Tools

A. Notification of Initial Find of EAB Prior to General Release

Following positive identification of the first or subsequent sample, notification of a variety of individuals must occur prior to the general release of the information. The list of individuals to be notified may vary somewhat depending on the location of the find.

Appropriate agency managers and core staff will be among those who are notified early in the response. Each partner agency will be responsible for determining and carrying out its own internal notification plan.

Others potentially receiving advanced notification include local, state and federal lawmakers and elected officials, agency staff with associated responsibilities, stakeholder and partner groups, and property owners or managers where the finds occur. A notification protocol has been developed for advanced notification to the appropriate persons in the event of a find of EAB on private, public, Tribal or federal lands.

B. Communication with Native American Tribes in Wisconsin

Native American Indian Tribes in Wisconsin are separate governmental entities, and Wisconsin state agencies interact with tribes on a government-to-government basis.

Wisconsin agencies charged with preparing for, and responding to, the threat of EAB have been, and will continue to be, in communication with the Tribes and with federal agencies that work on their behalf, including the Bureau of Indian Affairs and the Great Lakes Indian Fish and Wildlife Commission.

Communication with affected Native American Tribes should be timely and consistent, placing a high priority on cooperation with the Tribes to seek an effective control plan for areas in and around Tribal lands.

C. Communication Tools

A combination of communication and outreach tools will likely be necessary to reach the largest possible number of affected individuals, businesses and organizations within an area of infestation.

1. Internet

A growing number of people rely on the Internet for news and information. The Wisconsin Emerald Ash Borer Web Portal will be one of the primary ways that the Program communicates with the public and media. The portal address is **www.emeraldashborer.wi.gov**. The portal may also be reached through this address, **www.banthebeetle.wi.gov**. Additional Internet resources for EAB

information exist at **www.emeraldashborer.info** and within each of the state agencies (DATCP, DNR, UW) responding to the infestation. The USDA Forest Service and APHIS-PPQ also have Web pages dedicated to emerald ash borer information.

2. Press Releases
Information to the media is primarily delivered through press releases. Press releases, or press advisories, may be issued as necessary to announce Program initiatives, community meetings, delimitation survey results, and related information. Agency professionals will prepare and disseminate press releases with the approval of the Advisory Group, the Incident Commander, or a chosen representative of either. It is expected that each agency may also issue separate press releases on related topics, but not regarding the Program as a whole. All press releases and advisories should be shared with appropriate agency colleagues, partners, stakeholders, lawmakers, and the like.

3. Informed Partners
There exist in some agencies specific groups or individuals who may not be directly involved in a response to an EAB infestation, but because of their positions or connections to people or groups in the state, county, municipality or region, will be important avenues for communicating Program information. Examples include UW-Extension agents and master gardeners, DNR regional urban forestry coordinators, and DATCP nursery inspectors.

4. Community Forums
Face-to-face communication with affected individuals and parties is important and will be given high priority throughout all phases of the response. Forums or open houses allow local citizens the opportunity to speak directly to Program representatives and agency staff to express concerns or to simply gather additional information.

5. Printed Materials
A number of materials already exist that cover a variety of Program components or specific EAB information. Additional materials to address local, specific needs may be necessary to produce. In-house graphic artists or private contractors are readily available to do this work. Normal state printing procedures and guidelines may need to be temporarily circumvented in order to provide materials to affected citizens and businesses in a timely manner.

6. Commercial Advertising
While a considerable amount of information will likely be disseminated through unpaid media channels in the way of news reporting, it may also be necessary to procure advertising on radio, television or newspapers to reach a greater audience. Budget constraints must be considered prior to moving forward with any paid advertising plans.

References used in development of plan and appendices

Delimitation of infestation

- Ryall, K. L., J. G. Fidgen, and J.J. Turgeon. 2010. Detection of emerald ash borer in urban environments using branch sampling. Canadian Forest Service Technical note #111, Frontline Forestry Research Applications.

Eradication

- McCullough, D.G., T. Poland and D. Cappert. 2003. Dispersal of Emerald Ash Borer: A Case Study At Tipton, Michigan. In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro and R. Reardon (Compilers). Port Huron, Michigan. September 30–October 1, 2003. USDA FHTET-2004-02. p.6.

- McPartlan, D., P. Bell, C. Kellogg. 2006. Eradication of Emerald Ash Borer in Michigan, Ohio, and Indiana; Implementation of the Strategic Plan (2005, 2006). USDA, APHIS PPQ Pest detection and management program staff, 4700 river Rd., Riverdale, MD 20738.

- Sargent, C.,D. Bean, M. Raupp, A.J. Sawyer. 2009, Emerald Ash Borer Dispersal in Maryland: Go Forth Young Pest! In *Proceedings of the USDA Research Forum on Invasive Species 2009.* p. 93-94

- Siegert, N. 2011, Economics of eradicating EAB satellite infestations. In *Proceedings, 22nd USDA Interagency Research Forum on Invasive Species 2011*

Insecticides

- Cappaert, D., D. McCullough and T. Poland. 2007. Effects of trunk injection on emerald ash borer density and ash survival: a four-year study. In *Proceedings of Emerald ash borer and Asian longhorned beetle research and technology development meeting*. V. Mastro, D. Lance, R. Reardon and G. Parra (Compilers). Cincinnati, Ohio, October 29-November 2, 2006. USDA FHTET-2007-04. pp. 48-51.

- Herms, D.A., D.G. McCullough, D.R. Smitley, C.S. Sadof, R.C. Williamson, P.L. Nixon. 2009. Options for Protecting Ash Trees from

Emerald Ash Borer. North Central IPM Center Bulletin. 12 pp. http://emeraldashborer.wi.gov Accessed March 2011.

- Lewis, P. A., D. Smitley, R. Reardon and V. Mastro. 2007. Aerial Application of spinosad for emerald ash borer control in woodlots. In *Proceedings of Emerald ash borer and Asian longhorned beetle research and technology development meeting*. V. Mastro, D. Lance, R. Reardon and G. Parra (Compilers). Cincinnati, Ohio, October 29-November 2, 2006. USDA FHTET-2007-04. pp. 57-58.

- McCullough, D.G, D. Cappaert and T.M. Poland. 2005. Evaluation of insecticides to control emerald ash borer: Summary of 2004 trials. http://www.emeraldashborer.info/treatment.cfm, Updated April 2005, accessed February, 2008.

- McCullough, D. G., D. Smitley and T. Poland. Evaluation of insecticides to control emerald ash borer adults and larvae. http://www.emeraldashborer.info/files/bulletin.pdf. Accessed February, 2008.

- Mercader, R.J., N.W. Siegert, A.M. Liebhold, and D.G. McCullough. 2011. Simulating the effectiveness of three potential management options to slow the spread of emerald ash borer (*Agrilus planipennis)* populations in localized outlier sites.

- Raupp, M.J., R.E. Webb, A. Szczepaniec, D. Booth, and R. Ahern. 2004. Incidence, abundance, and severity of mites on hemlocks following applications of imidicloprid. Journal of Arboriculture 30(2):108-113

- Sadof, C.S. 2008. Emerald Ash Borer Cost Calculator. http://www.extension.entm.purdue.edu/treecomputer/ accessed April 2011.

- Sclar, D.C., D. Gerace, and W.S. Cranshaw. 1998. Observations on population increases and injury by spider mites (Acari: Tetranychidae) on ornamental plants treated with imidacloprid. J. Econ. Entomol. 91:250–255.

- VanNatta, A.R., N.M. Schuettpelz, and R.H. Hauer1. 2010. Cost Analysis of Removal and Replacement vs. Treatment of Ash Trees Susceptible to Emerald Ash Borer (*Agrilus planipennis*) on the UW-Stevens Point Campus. Proceedings of the International Society of Arboriculture 86th Annual Conference. Chicago, IL, July 23 – 28, 2010.

Attract and Remove

- Fraser, I., J. Francese, D. Lance, D. Crook, J. Oliver, N. Youssef and V. Mastro. 2006. Effects of tree wounding and banding on Emerald Ash Borer Capture. In Proceedings of *Emerald ash borer beetle research and technology development meeting*. V. Mastro, R. Reardon and G. Parra (Compilers). Pittsburg, PA, September 26-27, 2005. USDA FHTET-2005-16. pp. 59-60.

- McCullough, D., T. Poland and D. Cappaert. 2006. Attraction of Emerald Ash Borer to Trap Trees: Effects of Stress Agents and Trap height. In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro, R. Reardon and G. Parra (Compilers). Pittsburg, PA, September 26–27, 2005. USDA FHTET-2005-16. pp.61-62.

- McCullough, D., N. Siegert. Using girdled trap trees for EAB detection, delimitation and survey. 2006. http://www.emeraldashborer.info/Research.cfm. Accessed February, 2008.

- Oliver, J.B., J. Francese, V. Mastro, I. Fraser, D. Lance and N. Youssef. Studies to develop an emerald ash borer survey trap – Seedling tree damage. 2005. http://www.emeraldashborer.info/Research.cfm

- Poland, T., P. de Groot, G. Grant, L. MacDonald, and D. McCullough. 2004. Developing attractants and trapping techniques for the emerald ash borer. In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro and R. Reardon (Compilers). Port Huron, Michigan. September 30–October 1, 2003. USDA FHTET-2004-02. pp.15-16.

- Poland, T., C. Rodriguez-Saona, G. Grant, L. Buchan, P. de Groot, J. Miller and D. McCullough. 2006. Trapping and detection of emerald ash borer: identification of stress-induced volatiles and tests of attraction in the lab and field. In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro, R. Reardon and G. Parra (Compilers),Pittsburg, PA, September 26–27, 2005. USDA FHTET-2005-16. pp. 64-65.

- Rodriguez-Saona, C, T. Poland, J. Miller, L. Stelinski, G. Grant, P. de Groot, L. Buchan, L. MacDonald. 2006. Behavioral and electrophysiological responses of the emerald ash borer, *Agrilus planipennis*, to induced volatiles of Manchurian ash, *Fraxinus mandshurica*. Chemoecology 16: 75-86.

Phloem reduction

- Ash reduction model. http://www.ashmodel.org. Forest resources and environmental science, Michigan Tech. University. Updated May, 2007, accessed November, 2007.

- Eberhart, T.L, A.J. Storer and L.M. Nagel. 2007. Living with emerald ash borer: development and implementation of an ash reduction model to reduce the population potential of emerald ash borer. In *Proceedings of Emerald ash borer and Asian longhorned beetle research and technology development meeting.* V. Mastro, D. Lance, R. Reardon and G. Parra (Compilers) Cincinnati, Ohio. October 29-November 2, 2006. USDA FHTET-2007-04. p 24.

- Gandhi, K.J.K, A. Smith, R.P. Long, and D. Herms. 2007. Patterns of emerald ash borer-induced ash decline and mortality in the forests of southeastern Michigan. In *Proceedings of Emerald ash borer and Asian longhorned beetle research and technology development meeting.* V. Mastro, D. Lance, R. Reardon and G. Parra (Compilers). Cincinnati, Ohio. October 29-November 2, 2006. USDA FHTET-2007-04. pp. 26-27.

- McCullough D.G. and N. W. Siegert. 2007. Estimating potential emerald ash borer (Coleoptera: Buprestidae) populations using ash inventory data. J. Econ. Entomol. 100(5): 1577-1586.

Biological Control

Pathogens

- Liu, H.; and L.S. Bauer. 2006. Susceptibility of *Agrilus planipennis* (Coleoptera: Buprestidae) to Beauveria bassiana and *Metarhizum anisopliae.* J. Econ. Entomol. 99: 1096-1103.

Parasites

- Bauer, L.S.; H. Liu; R.A. Haack; T.R. Petrice; and D.L. Miller. 2003. Natural enemies of emerald ash borer in southeastern Michigan. . In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro and R. Reardon (Compilers). Port Huron, Michigan. September 30–October 1, 2003. USDA FHTET-2004-02. p. 33.

- Bauer, L.S.; H. Liu; R.A. Haack; T.R. Petrice; and D.L. Miller. 2004. Emerald ash borer natural enemy surveys in Michigan and China. In *Proceedings of Emerald Ash Borer Research and Technology Development Meeting*. V. Mastro and R. Reardon (Compilers). Romulus, Michigan, October 5-6, 2004. USDA FHTET-2004-15, pp 71-72.

- Bauer, L.S.; and H. Liu. 2005. Egg and larval parasitoids of EAB from China: potential for biocontrol in North America. In *Proceedings of Emerald ash borer research and technology development meeting*. V. Mastro, R. Reardon and G. Parra (Compilers). Pittsburg, PA, September 26–27, 2005. USDA FHTET-2005-16. pp. 48-49.

- Gould, J.; L.S. Bauer; H. Liu; D. Williams; P. Schaefer; and R. Reardon. 2005. Potential for biological control of the emerald ash borer. In *Proceedings of the USDA Research Forum on Gypsy Moth and Other Invasive Species*, Annapolis, MD, USDA FS GTR NE-337.

- Liu, H.; L.S. Bauer; R. Gao; T. Zhao; T.R. Petrice; and R.A. Haack. 2003. Exploratory survey for the emerald ash borer, *Agrilus planipennis* (Coleoptera: Buprestidae), and its natural enemies in China. Great Lakes Entomol. 36, 191-204

- Liu, H.; L.S. Bauer; D.L. Miller; T. Zhao; R. Gao; L. Song; Q. Luan; R. Jin; and C. Gao. 2007. Seasonal abundance of *Agrilus planipennis* (Coleoptera: Buprestidae) and its natural enemies *Oobius agrili* (Hymenoptera: Encyrtidae) and *Tetrastichus planipennisi* (Hymenoptera: Eulophidae) in China. Biological Control. 42: 61-71.

- Yang, Z-Q.; J.S. Strazanac; Y. Yao; and X. Wang. 2006. A new species of emerald ash borer parasitoid from China belonging to the genus *Tetrastichus* Haliday (Hymenoptera: Eulophidae). Proc. Entomol. Soc. Wash. 108: 550-558.

- Yang, Z-Q, Strazanac, J.S., Marsh, P.M., van Achterberg, C., Choi,W-Y. 2005. First recorded parasitoid from China of *Agrilus planipennis:* A new species of *Spathius* (Hymenoptera: Braconidae, Doryctinae). Ann. Entomol. Soc. Am. 98: 636-642.

- Zhang, Y-Z.; D-W. Huang; T-H. Zhao; H-P. Liu; and L.S. Bauer. 2005. Two new egg parasitoids (Hymenoptera: Encyrtidae) of economic importance from China. Phytoparasitica 33: 253-260.

<u>Government Documents and Reports</u>

- USDA APHIS. 2007. Proposed release of three parasitoids for the biological control of the emerald ash borer (*Agrilus planipennis*) in the continental United States. Environmental Assessment, dated April 2, 2007, 60 p.

- Unknown author. 2007. Petition for release of the exotic parasitoid *Oobius agrili* for biological control of the emerald ash borer, *Agrilus planipennis*.

- Unknown author. 2007. Petition for release of the exotic parasitoid *Tetrastichus planipennisi* for biological control of the emerald ash borer, *Agrilus planipennis*.